Attribute No. 1.
Spatially Complex Channel Morphology

No single segment of channelbed provides habitat for all species, but the sum of all channel segments provides high-quality habitat for native species. A wide range of structurally complex physical environments supports diverse and productive biological communities (Anderson and Nehring, 1985; Sullivan et al., 1987; Bisson et al., 1988; Hill et al., 1991).

Desired Physical Responses:

- An alternate bar morphology extending upstream from the present alluvial transition zone near Indian Creek.
- Development of a functional floodplain, now missing from the post-TRD channel morphology.
- Asymmetrical cross-sections in a meandering channel with a sinuous thalweg pattern.

Desired Biological Responses (if all annual hydrograph components are provided)

- Riparian community with all stages of successional development.
- No loss of riparian habitat with channel migration.
- Diverse salmonid habitat available for all life stages over wide-ranging flows, flood and baseflow (Hill et al., 1991; Reeves et al., 1996; *in* Poff et al., 1997).

Attribute No. 2.
Flows and Water Quality Are Predictably Variable

Inter-annual and seasonal flow regimes are broadly predictable, but specific flow magnitudes, timing, duration, and frequencies are unpredictable because of runoff patterns produced by storms and droughts. Seasonal water-quality characteristics, especially water temperature, turbidity, and suspended-sediment concentration, are similar to those of regional unregulated rivers and fluctuate seasonally. This temporal "predictable unpredictability" is a foundation of river ecosystem integrity (Hill et al., 1991; Poff et al., 1997; Richter et al., 1997).

Objectives for Physical Processes:

- Inundate lower alternate bar features during dispersion of riparian plant seeds.
- Provide variable water depths and velocities over spawning gravels during salmonid spawning to spatially distribute redds.
- Inundate broader margins of alternate bars, including backside scour channels, to create shallow slack areas between late winter and snowmelt periods for early life stage of salmonids and amphibians.
- Provide a favorable range of baseflows for maintaining high-quality juvenile salmonid rearing and macroinvertebrate habitat within an alternate bar morphology.
- Provide late-spring outmigrant stimulus flows.
- Rapid post-snowmelt recession stage to strand/desiccate seedlings initiating/establishing on alternate bar surfaces.

Desired Physical Responses:

- Restore physical/riparian processes associated with a snowmelt peak and recession hydrograph components below Lewiston Dam.
- Optimize available physical habitat for anadromous salmonids for all seasons.
- Restore periodic inundation of the floodplain and groundwater dynamics.

Desired Biological Responses (if all annual hydrograph components provided):

- Elimination of most woody riparian cohorts from exposed surfaces of alternate bars.
- Establishment of early-successional riparian communities on floodplains and terraces.
- Improved anadromous salmonid egg survival.
- Natural seasonal timing of hydrograph components to complement life-history requirements of native plants and animals.
- Greater channel complexity, more habitat, and higher water quality for all freshwater life-history stages of salmonids.
- Increased macrobenthic invertebrate productivity.

Attribute No. 3.
Frequently Mobilized Channelbed Surface

Channelbed framework particles of coarse alluvial surfaces are mobilized by the bankfull discharge (Leopold et al., 1964; Richards, 1982; Nelson et al., 1987), which occurs on average every 1 to 2 years.

Objectives (every two of three years as an annual maximum):

- Achieve incipient condition for general channelbed surface.
- Surpass threshold for transporting sand through pools.
- Scour 1- to 2-year-old seedlings on alternate and medial bars.
- Frequently mobilize spawning gravel deposits.

Desired/Diagnostic Physical Responses:

- Mobilize surface rocks (D_{84}) in general channelbed surface and exposed portions of alternate bars.
- Reduce coarseness of surface layer above Indian Creek.
- Reduce sand storage in riffle/run habitat and pools.
- Create local scour depressions around large roughness elements.
- Mobilize spawning gravel deposits several surface layers deep.

Desired Biological Responses (if physical processes achieved):

- Higher survival of eggs and emerging alevins by reducing fines (Tagart, 1984; Sear, 1995; Poff et al., 1997).
- Greater substrate complexity in riffle and run habitats for improved macroinvertebrate production (Boles, 1976; Nelson et al., 1987; Ward, 1998).
- Scour 1-and 2-year-old woody riparian seedlings along margins of alternate bars.

- Greater habitat complexity (micro-habitat features).
- Deeper pool depths/volumes for adult fish cover and holding (Platts et al., 1983; Nelson et al., 1987; Sullivan et al., 1987; Bisson et al., 1988; Barnhart and Hillemeier, 1994).

Attribute No. 4.
Periodic Channelbed Scour and Fill

Alternate bars are scoured deeper than their coarse surface layers by floods exceeding 3- to 5-year annual maximum flood recurrences. This scour is typically accompanied by re-deposition, such that net change in channelbed topography following a scouring flood usually is minimal.

Objectives for Physical Processes:

- Rejuvenate spawning gravel deposits.
- Kill 2- to 4-year-old seedlings establishing on alternate bar surfaces.
- Deposit fine substrate onto upper alternate bar and floodplain surfaces.

Desired Physical Responses:

- Close to dam, reduction in surface-to-subsurface D_{50} and D_{84} particle-size ratios.
- Significant scouring (several surface layers deep) of most alluvial features, including steeper riffles.
- Formation of alternate bar sequences upstream from Indian Creek.
- More alternate bars and developing bar sequences downstream from Douglas City.
- Increased diversity of surface particle-size distributions.
- Greater topographic complexity of side channels associated with alternate bars, especially distal portions.
- Increased pool depths.

Desired Biological Responses (if physical processes achieved):

- Improved anadromous salmonid spawning and rearing habitat (Hill et al., 1991).
- Reestablishment of dynamic riparian plant stands in various stages of succession on higher elevations of alternate bars.
- Mortality of 3- to 4-year-old saplings on alternate bar surfaces to discourage riparian plant encroachment and riparian berm formation.
- Rehabilitation of habitat for riparian-dependent amphibian, bird, and mammal species.

Attribute No. 5.
Balanced Fine and Coarse Sediment Budgets

River reaches export fine and coarse sediment at rates approximately equal to sediment inputs. The amount and mode of sediment storage within a given river reach fluctuates, but channel morphology is sustained in dynamic quasi-equilibrium when averaged over many years (Sear, 1994; Poff et al., 1997).

Objectives for Physical Processes:

- Reduce fine sediment storage in the mainstem.
- Maintain coarse sediment storage in the mainstem.
- Route mobilized D_{84} through alternate bar sequence every two of three years, on average.
- Prevent mainstem accumulation of tributary bed material.
- Eliminate bedload impedance reaches.

Desired Physical Responses:

- D_{84} tracer rocks should negotiate alternate bar sequences; i.e., larger particles from upstream riffles should not accumulate in downstream pools.
- Reduced storage of fine sediment in riparian berms.
- Eliminate aggradation, and encourage slight degradation of bed elevation at tributary deltas (smooth-out longitudinal profile through these reaches).
- Increases pool depths.
- Maintains physical complexity by sustaining alternate bar morphology.

Desired Biological Responses:

- Improves and maintain spawning and rearing habitat quality without reducing quantity (Poff et al., 1997).
- Increases adult salmonid cover and holding (Nelson et al., 1987).
- Reduces riparian berms.

Attribute No. 6.
Periodic Channel Migration

The channel migrates at variable rates and establishes meander wavelengths consistent with regional rivers with similar flow regimes, valley slopes, confinement, sediment supply, and sediment caliber (Williams and Wolman, 1984; Chien, 1985, in Poff et al., 1997; Sullivan et al., 1987; Johnson, 1994).

Objectives for Physical Processes:

- Promote bank erosion in alluvial reaches.
- Floodplain deposition every 3 to 5 years.
- Create channel avulsions every 10 years on average.

- Encourage meander wavelengths 8 to 10 bankfull-widths long.
- Stored sediment in the floodplain is slowly released downstream.

Desired Physical Responses:

- Maintain channel width while channel migrates.
- Create sloughs through infrequent channel avulsions.
- Create side channels through frequent alternate bar reshaping.
- Increase meander amplitude and expression of the thalweg.
- Create water temperature variability within alternate bar sequences.
- Increase input of large woody debris along channel margins.

Desired Biological Responses (if all physical objectives achieved):

- Diverse age class structure in stands of cottonwood and other species dependent on channel migration.
- Full range of seral stages in riparian plant communities.
- Increased habitat quality and quantity for native vertebrate species dependent on early successional riparian forests (Hartman, 1965; Bustard and Narver, 1975; Sullivan, 1987).
- High flow refuge and summer thermal refugia for amphibians and juvenile fish provided in rejuvenated scour channels.
- Increased habitat complexity by input of large woody debris from eroding banks.

Attribute No. 7.
A Functional Floodplain Floodplain

On average, floodplains are inundated once annually by high flows equaling or exceeding bankfull stage. Lower terraces are inundated by less frequent floods, with their expected inundation frequencies dependent on norms exhibited by similar, but unregulated river channels. These floods also deposit finer sediment onto the floodplain and low terraces (Leopold et al., 1964; Sullivan, 1987; Poff et al., 1997; Ward, 1998).

Objectives for Physical Processes:

- Inundate the floodplain on average once annually.
- Encourage local floodplain surface deposition and/or scour by less frequent but higher floods.
- Have floodplain construction keep pace with floodplain loss as the channel migrates across the river corridor.
- Provide sufficient channel confinement to maintain hydraulic processes (Attribute Nos. 3 and 4).

Desired Physical Responses:

- Maintain channel width as river migrates.
- Increase hydraulic roughness and greater flow storage during high-magnitude floods.

Desired Biological Responses (if all physical objectives achieved):

- Increased woody riparian overstory and understory species diversity, compensating for woody riparian stands lost along outside banks of eroding meander bends.
- Keeps physical processes conducive for maintaining early-successional riparian dependent species, especially for birds and amphibians.

Attribute No. 8.
Infrequent Channel-Resetting Floods

Single large floods (e.g., exceeding 10- to 20-year recurrences) cause channel avulsions, widespread rejuvenation of mature riparian stands to early-successional stages, side channel formation and maintenance, and off-channel wetlands (e.g., oxbows). Resetting floods are as critical for creating and maintaining channel complexity as are lesser magnitude floods (Sullivan et al., 1987; Poff et al., 1997; Ward, 1998).

Objectives for Physical Processes:

- Form/Reshape alternate bar surfaces every 10 to 20 years, on average.
- Improve bedload routing by minimizing impedance of bedload transport past tributary deltas.
- Eliminate or minimize extent of mature riparian vegetation stands on alternate bar surfaces and floodplains every 10 to 20 years.
- Deposit fine substrate on lower terrace surfaces once every 10 to 20 years.
- Provide infrequent deep scour high on alternate bars and on the floodplain.
- Construct and maintain (rejuvenate) natural side channels.
- Scour and redeposit entire alternate bar sequences every 10 to 20 years.

Desired Physical Responses:

- Deep scour (several D_{84} surface layers deep) in most alluvial features, including steeper riffles.
- Significant channel migration and infrequent channel avulsion.
- Alternate bar scour and redeposition.
- Extensive removal of saplings and mature trees in riparian stands.
- Increase complexity of natural side channels.

Desired Biological Responses (if physical processes achieved):

- Improve anadromous salmonid spawning and rearing habitats.
- Increase adult fish cover and holding habitat (Nelson et al., 1987).
- Create dynamic riparian stands in various stages of succession on higher elevations of alternate bars.
- Control populations of 3- to 4-year-old saplings on alternate bar surfaces close to channel center, and scour stands of mature riparian vegetation.

Attribute No. 9.
Self-Sustaining Diverse Riparian Plant Communities

Natural woody riparian plant establishment and mortality, based on species life history strategies, culminate in early- and late-successional stand structures and species diversities (canopy and understory) characteristic of self-sustaining riparian communities common to regional unregulated river corridors (Beschta and Platts, 1986; Ligon et al., 1995; Poff et al., 1997).

Objectives for Riparian Processes:

- Prevent woody riparian plant encroachment.
- Maintain early-successional woody riparian communities.
- Remove mature riparian trees established in the riparian berms.
- Eliminate widespread presence of riparian berms.
- Rehabilitate off-channel wetland communities.

Desired Biological Responses (if all physical objectives achieved):

- Floods periodically scour seedlings and saplings.
- Channel migration initiates new riparian cohorts.
- Channel avulsion creates oxbows and off-channel wetland habitats, initiating diverse patches of riparian stands.
- Woody riparian overstory and understory species diversity and age class distribution increases in floodplains.
- Greater habitat availability for wildlife dependent on early seral stages of riparian plant communities.

Attribute No. 10.
Naturally-fluctuating Groundwater Table

Inter-annual and seasonal groundwater fluctuations in floodplains, terraces, sloughs, and adjacent wetlands occur in a manner similar to that in regional unregulated river corridors (Stanford et al., 1996; Ward, 1998).

Objectives for Physical Processes:

- Naturally fluctuating seasonal groundwater elevation and surface-water elevations in scour channels and off-channel wetlands.

Desired Physical Responses:

- Maintenance of off-channel habitats, including overflow channels, oxbow channels, and flood-plain wetlands.

Desired Biological Responses (if physical processes achieved):

- High diversity of habitat types within the entire river corridor (Poff et al., 1997; Ward, 1998).